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PATENTS FORM NO. 5PATENTS ACT 1953COMPLETE SPECIFICATION"METHOD AND DEVICE FOR FORMING A PLANAR FLEXIBLE WEB INTO A COLLAPSIBLE TUBE"

WE, AMERICAN CAN COMPANY, an American Company, of 100 Park Avenue, New York 17, N.Y. United States of America, hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to a method and a device for forming a planar flexible web into a collapsible tubular shape defined by the surface of a forming mandrel about which successive increments of said web are wrapped, whereafter the adjacent edges of each increment, which extend longitudinally of said mandrel, are connected to each other to constitute a longitudinal seam of the tube thus produced.

The invention is more particularly applicable to the forming of tubing from a continuous web of heat-fusible material, such as plastic or a laminate of plastic, metallic foil, etc., which tubing is then to be cut into body-size lengths used in the manufacture of collapsible tube containers.

Plastic tubing for making collapsible container bodies can be manufactured in a number of ways. One of the most economical ways has been to form the tube by continuous extrusion, and this is the technique ordinarily practiced where the tube body is made entirely of plastic, e.g., polyethylene, polyvinyl chloride, etc. Another technique is to form the tubing from a supply of flat web stock by progressively folding the web around a forming horn or mandrel and seaming its edges together. This latter technique has particular utility and advantages in the making of container bodies of laminated construction comprising one or more plies of a thermoplastic material and one or more layers of a barrier material, such as metallic foil. This enables the use of a wide range of plastic films having special physical and chemical characteristics, and also permits greater versatility in certain of the important secondary operations of collapsible tube body manufacture. For example, pre-printing of

the flat body stock, either on the barrier layer or on one of the plastic films, enables greater versatility and selection in decorative artwork and ordinarily is faster and therefore more economical than printing on the preformed tubular bodies.

5 The present invention is aimed at providing a particularly economical and efficient method of an apparatus for continuously forming a flat web, which may be of the above mentioned laminate construction, into a tubular shape which may then be cut into a plurality of collapsible tubular container bodies.

10 The method according to the invention is characterized in that it comprises the steps of :

- continuously feeding said web along said mandrel in the direction of the longitudinal axis of said web, one face of the latter being in contact with the mandrel surface ;

- continuously feeding, at the same time and in the same direction, a flexible elastic band-like sheet member having a width slightly smaller than that of said web, one face of said sheet member being in contact with the other face of said web, and the longitudinal axis of said sheet member substantially coinciding with said longitudinal axis of the web, whereby said sheet member covers a major central portion of said other web surface, while two opposite longitudinal marginal portions of said web remain free of said sheet member ;

25 guiding the other face of said sheet member so as to apply the latter together with said web around said mandrel, whereby the successive web increments fed along said mandrel are formed into tubular shape while said free marginal web portions extend along a longitudinal mandrel zone in closely adjacent relation with respect to each other ;

- and bonding the successive increments of said adjacent free marginal web portions to each other during their displacement along said longitudinal mandrel zone.

The device for carrying out the above method according to the invention comprises a forming mandrel and means for feeding along the latter a web to be formed into tubular shape about said mandrel, and is characterized in that said web feeding means are adapted to feed the web continuously and in the direction of the longitudinal axis of the web in such a way that one face of the latter engages the peripheral surface of the mandrel, a flexible elastic band having a width smaller than that of said web being fed by band feeding means in a direction and at a speed equal to those of the web feeding motion, one face of said band being in contact with the other web face, and the respective longitudinal axes of said band and said web substantially coinciding with each other ; said mandrel being located within a guiding member a concavely curved guiding wall of which coaxially surrounds a major portion of the periphery of said mandrel so as to define therewith a guiding passage having a radial width substantially equal to the combined thicknesses of said web and said band, for guiding said band together with said web along said mandrel and applying them to the periphery thereof ; bonding means arranged along the remaining minor longitudinal portion of the mandrel periphery which is not surrounded by said guiding wall, for bonding to each other the opposed longitudinal marginal portions of said web, which are displaced in closely adjacent relationship along said minor mandrel periphery portion.

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Numerous other features and advantages of this invention will become apparent from the following description which, taken in connection with the accompanying drawings and appended claims, particularly sets forth the various novel features of the invention in a preferred embodiment thereof.

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Referring to the drawings :

- Fig. 1 is a perspective view of one form of machine, with parts broken away, for practicing our invention ;
- Fig. 2 is a top plan view of a portion of the machine illustrated in Fig. 1, partially shown in section.
- Fig. 3 is a fragmentary longitudinal side view, partially in section, of a portion of the machine;
- Figs. 4 and 5 are fragmentary sectional views, on an enlarged scale, taken substantially on lines 4-4 and 5-5, respectively, of Fig. 3.

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Referring now to Fig. 1, there is illustrated a preferred or exemplary form of apparatus for carrying out our invention. This comprises an endless flexible belt 10, of leather or elastomeric material, entrained over a plurality of stationary rollers 11-16 journaled in a frame (not shown), some or all of which rollers may be adjustably mounted in suitable bearings to enable adjustment in the tension and disposition of the belt. Roller 11 is a driver roller and is coupled with a suitable motor and speed control unit (not shown) for driving the belt at a selected speed. The remaining rollers 12-16 are idler or guide rollers, with rollers 14 and 15 being mounted at the lead-in and lead-off ends, respectively, of a tube forming unit generally designated 17, hereinafter to be described.

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Also mounted to the frame at the lead-in end of the apparatus is a spindle, 18 which supports a coil or roll 19 of web material W from which the tubing is made. This web material may be an all-plastic film or a laminate of several layers of thermoplastic films and barrier films, depending, of course, on the construction of tubing which is desired to be formed. By way of illustration and not limitation, web W will be taken throughout this description as referring to a laminate of two films of thermoplastic of like or dissimilar material, with an intermediate barrier layer of metallic foil. While forming no part of the instant invention, a laminated web of the type referred to customarily is formed by continuously extruding the two thermoplastic films onto the opposite surfaces of the intermediate foil layer. In such an operation, printing and other decorative indicia may be applied either to the foil or to either side of one of the thermoplastic films, whichever is preferred, while these films are in the flat and before bonding together into the laminate web W. Ordinarily, a larger web of several body-size widths would be made by this procedure and then slit into individual webs W and rolled into coils 19. It is envisaged that, for certain operations, it may be desirable to form the tubing from the web as it comes directly from the extrusion-lamination operation. In this case, the web W would not be rolled into coil form and, therefore, the spindle 18 could be dispensed with.

Whether supplied directly from an extrusion-lamination operation or from coil 19, the web W is fed over a guide and tensioning roller 20 and into overlying frictional engagement with belt 10. The width of the web is slightly greater than

that of belt 10 so that the opposite longitudinal edges, w_1 and w_2 , extend beyond the edges of the belt. A force or pressure roller 21 directs the web firmly against the belt so that the web is fed by and at the same speed as the belt into and through the forming unit 17. The web is formed into a tubular configuration and seamed in the forming unit by a seaming unit generally designated 23, in a manner next to be described, and exits from the lead-off end of the unit as a fully formed continuous tube T. The belt 10 then separates from the tube as it returns over roller 15, and the tube continues on to a cutter unit 22 which cuts into body-size lengths.

The forming unit 17 comprises an elongate horn or mandrel 24 supported in cantilever fashion to the frame of the apparatus on a heavy bracket 25 (Figs. 2 and 3) and a forming block 26 to the top of which is fixed a guide plate 27 having a longitudinal slot 28 extending from the lead-out end for substantially its full length. The block 26 and plate 27 are interiorly contoured with a generally cylindrical surface 29 and, as a unit, provide a hollow member concentrically surrounding the mandrel 24. The diameter of surface 29 is greater than that of the mandrel an amount substantially twice the thickness of belt 10 and web W so as to allow the frictionally engaged belt and web to enter the space therebetween. The contour of surface 29 of the forming block 26 and guide plate 27 is not truly cylindrical for a portion of their length at the lead-in end, but for reasons that will be more fully explained as this description proceeds these members are appropriately interiorly shaped so that the web W is progressively folded about the mandrel and

sized as it is fed therealong by belt 10.

Sealing unit 23 comprises an exterior endless sealing band 30, an interior endless sealing band 31, an exterior heater bar 32; an interior heater bar 33 carried by mandrel 24 (Fig. 5), both preferably electrically heated, and a cooling unit 34, all operably arranged in longitudinal order along the forming unit 17 to press and fuse the opposite longitudinal edges w_1 and w_2 of web W together into a continuous seam S and cool the seam to a permanent set.

Exterior band 30 is entrained over a pair of rollers 35, 36, one of which is driven and the other an idler roller. The rollers and exterior band are so arranged that the lower race of the band passes into and operates within slot 28 provided in plate 27. The exterior band preferably is of thin flexible steel having its exterior surface coated with a layer of non-adherent material, such as "Teflon", to prevent sticking to the heated edges w_1 and w_2 as the seam S is being pressed together and formed.

Interior band 31 operates interiorly of the tube being formed and, accordingly, is arranged to move in close conformity with the exterior surface of mandrel 24. At the lead-in end of the forming unit, the interior band is entrained over a tension roller 37 and a pair of idler rollers 38, 39. At the lead-out end, interior band 31 makes a sharp turn around a roller 40 (fig. 2) mounted in the free end of mandrel 24.

The upper race of the interior band runs within a shallow longitudinal groove 41 formed within the upper surface of interior heater bar 33 embedded in mandrel 24 (Fig. 5). Groove 41 continues rearwardly beyond heater bar 33 to roller 40 at the free end of mandrel (Fig. 2) and, there-

fore, is formed in the upper surface of the mandrel proper for this distance. The depth of groove 41 is such that the upper surface of the band 31 substantially coincides with the peripheral surface of the mandrel and forms therewith a smooth, uninterrupted continuation of the interior forming surface. 5
The lower race of the interior band returns to the lead-in end of the mandrel in a longitudinal groove 42 formed in the bottom of the mandrel.

Because of the rigorous flexing which interior band 31 must sustain to enable it to operate within the confines of 10 the mandrel and negotiate the rather sharp turn over roller 40, it preferably is constructed of an elastomeric material capable of withstanding the prolonged stressing involved while also being a fairly good heat conductor. Fibreglass has been found satisfactory for this purpose, and band 31 formed of this material also may be impregnated or coated on its exterior surface with "Teflon", like exterior band 30, to prevent sticking to the heated edges w_1 and w_2 of the web W .

Specific reference now is made to Figs. 2 and 3 where the several elements making up the forming unit 17 are illustrated, partly in slightly exaggerated proportions and relationships for a clearer and more specific explanation of their construction and function. Mandrel 24 is shown formed at its lead-in end, where it joins with mounting bracket 25, with a small diameter portion 24a which extends a predetermined distance rearwardly and merges with a portion 24b of larger diameter. 25

This latter or rearward portion of the mandrel corresponds in diameter to the inside diameter of the tube T to be formed thereon and is of this size for the 30

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remaining length of the mandrel. In other words, mandrel portion 24b corresponds in size to the ultimate size of tube T, whereas forward portion 24a is undersized with respect to the ultimate size of the final tube shape. Shown exaggerated to illustrate this construction, portion 24a actually is smaller than portion 24b in diameter by a matter of only a few thousandths of an inch, e.g. 0,020 - 0,030 inch. The joinder between these mandrel portions 24a and 24b of slightly dissimilar diameter is effected by a short tapered portion 24c which, in reality, is not so nearly and abrupt joinder as the drawings here illustrated.

Forming block 26 and guide plate 27 are similarly constructed so that their interior surface 29 conforms, with slightly greater dimensions, to the different diameters of mandrel portions 24a and 24b. In addition, the forwardmost end of block 26 is interiorly countered with a tapered surface portion 29a which converges inwardly to a cylindrical surface portion 29b surrounding small diameter mandrel portion 24a. This converging surface portion of forming block 26 progressively translates each successive increment of web W, and, of course, belt 10 on which the web is frictionally carried, from a flat condition to the desired tubular configuration while simultaneously bringing the opposite longitudinal edges w₁ and w₂ into loosely overlapped relation. As hereinbefore mentioned, the width of belt 10 is less than that of the web W. Thus, although, the belt 10 is made to conform to the web as both pass through the forming station, the opposite longitudinal edges of the belt always remain spaced away from the edges w₁ and w₂ and the progressively folded web. For the remaining length of block 26 and plate 27,

rearwardly of mandrel portion 24a, the surrounding surface portion 29c is of a diameter corresponding, in the same relation, to mandrel portion 24b of larger diameter.

Thus, web W and belt 10 are guided through the forming unit and, in so doing, are progressively folded into tubular configuration, first along converging surface portion 29a, then into tight conformity with small diameter mandrel portion 24a, and finally along mandrel portion 24b where the folded web is finally and accurately sized and its overlapped edges fused together. To assist in shaping the web and bringing it to accurately sized conformity with mandrel portion 24b, a plurality of hour-glass rollers 43 may be mounted at spaced intervals along forming block 26 in peripheral conformity with cylindrical surface portion 29c.

The reason for this special and novel construction of mandrel 24 is to facilitate the accurate sizing of the web W as it is progressively formed on the mandrel and, in this same connection, to ensure the accurate and properlapping of edges w₁ and w₂ to form seam S. This result is illustrated perhaps best in Figs. 4 and 5. As the web W, rolled within belt 10, passes over the forward mandrel portion 24a (Fig. 4), each increment of the web is shaped in tight sliding conformity with this portion of the mandrel and its edges w₁ and w₂ are overlapped an amount slightly in excess of that which they ultimately assume as the web proceeds along the mandrel. At approximately midway of mandrel portion 24a, both the exterior band 30 and the interior band 31 have come into engagement with the outer and inner edge margins, respectively, of the web. At this point, the lower race of the exterior band and upper race of the interior band are

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running parallel to each other and the tension on the bands is such that the contiguous overlapped edge margins are tightly gripped together by those band races.

This slightly undersized increment of web W,
5 fully folded into tubular shape and with its overlapped edges tightly gripped between the sealing bands, next moves onto large diameter portion 24b of the mandrel (Fig. 5). Here, the undersized tubular increment is "expanded" or drawn out to its final size and overlapped edges w₁ and w₂ brought into their final position for seaming. At this time, the lower race of 10 the exterior band 30 is running in direct contact with the heated face of exterior heater bar 32, and the upper race of interior band 31 is running in groove 41 in direct contact with interior heater bar 33. Heat is transmitted from these 15 heater bars directly through the interposed band races to the lapped edges of the web W. It is for this reason that both bands 30 and 31 are made of a material of good thermal conductivity.

Heater bars 32 and 33 are of sufficient length to enable the overlapped edges to be brought to fusion temperature during the time interval that the edges for each incremental length of the web, moving at a predetermined linear speed, are present between the bars. The bars are appropriately spaced apart from each other an amount just sufficient to accommodate the combined thickness of the overlapped edges and the two races of the sealing bands. As such, the bars actually exert pressure against the bands so that the overlapped edges are tightly pressed together as they fuse.
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The now fused edges, still tightly gripped between sealing bands 30 and 31, continue on along mandrel 24 to a

cooling zone. This cooling zone is maintained by cooling unit 34 which is disposed rearwardly of heater bar 32 and in longitudinal engagement with the lower race of band 30 in substantially the same relationship with the band and lapped edges w_1 and w_2 as is the heater bar 32 with the preceding increment. Cooling unit 34 is provided with suitable internal passages (not shown), through which a suitable refrigerant is circulated via an inlet conduit 44 and outlet conduit 45.

In addition to cooling unit 34, the rearward end of mandrel 24 for a length coextensive with the length of unit 34, is also internally chilled to facilitate cooling and setting of seam S. Internal cooling passages may be formed in the mandrel proper or an insert bar with suitable passages may be set in a groove cut in the mandrel surface much in the same manner as interior heater bar 33. Whichever the case, these passages are disposed close to the mandrel surface in longitudinal parallel relation with the upper race of interior sealing band 31, and are connected with an inlet passage 46 and an outlet passage 47 extending from the lead-in end of the mandrel and which connect with a suitable supply of refrigerant. Heat is extracted from the fused seam S through the lower race of exterior band 30 and the upper race of interior band 31 by the chilled contacting surfaces of the mandrel and cooling unit 34.

The tube T then emerges from the lead-out end of the forming and sealing units with seam S solidified in a permanent state. Forming belt 10 separates from the now finished tube and begins its return run around roller 15. Tube T continues onto the cutting unit 22 where it is cut into body-size lengths.

Both the exterior heater bar 32 and cooling unit 34
may be movably mounted on suitable actuating cylinders or
other mechanisms (not shown) so that, during periods of
shutdown or inactivity, these members may be shifted upwardly
5 out of engagement with the lower race of band 30.

Due to the relatively close spacing between the sur-
face of the mandrel 24 and surface 29 of the forming block 26,
it may be desirable to lubricate these surfaces to facilitate
the passage of the web W and the encircling belt 10 passing
therethrough. It has been found particularly advantageous
10 to maintain air films between the mandrel and the web and
between the belt and the forming block to reduce the friction
due to this close spacing. As illustrated in Fig. 5, a
satisfactory arrangement for providing a lubricating film
15 on the mandrel surface is in the form of a central passage 48
running the length of the mandrel and communicating with a
source of air (not shown), from which passage radiates a
plurality of smaller passages 49 spaced along the mandrel
and opening onto the mandrel surface. Similarly, the forming
block is provided with a plurality of longitudinal passages 50
20 appropriately circumferentially spaced about the mandrel,
and communicating with a source of air which may be the
same as that which supplies air to the mandrel. From these
passages 50, smaller passages 51 spaced at appropriate inter-
vals along the length of the mandrel open onto forming
25 surface 29. Air at relatively low pressure is emitted from
passages 49 and passages 51 to provide thin lubricating
films encircling the mandrel beneath web W and encircling
the belt 10 to the inside of surface 29. In this manner, the
web and belt wound upon the mandrel pass freely through the
30 length of the forming block 26 with a minimum of frictional
resistance.

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It is desirable that force roller 21 be positioned with respect to the longitudinal axis of the mandrel 24, so that undue local stressing and crowding of the web W as it takes shape around the mandrel is avoided. Because of the progressively converging pattern of the fold from the flat to tubular shape, it is apparent that the web W would tend to be stretched more along longitudinal lines closer to its edges than in its center. To avoid this, it is desirable that roller 21 be positioned so that this tendency to be stretched is equally distributed or neutralized throughout the width of the web. In one instance, satisfactory results were obtained where roller 21 was positioned so that its lower edge was in a plane passing over and tangentially to the upper surface of mandrel 24. In effect, this positioning ensures that all transverse portions in every increment of the web approach the surface of the mandrel at substantially the same angle of convergence so that the local stretching of the web as it is folded is distributed over its width between edges w_1 and w_2 . Naturally, it is preferred to have roller 21 and lead-in roller 14 adjustable to enable the greatest possible control over the approach attitude of the web. Also, roller 21 may be shaped with a greater diameter at its center than at its ends, as illustrated in Fig. 1, to give the web W an initial transverse bow or curvature as it approaches the mandrel.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction, and arrangement of parts of the apparatus mentioned herein and in the steps and their order of accomplishment of the method described

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herein, without departing from the ~~spirit and~~ scope of the invention or sacrificing all of its material advantages, the apparatus and method hereinbefore described being merely a preferred embodiment thereof.

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~~WHAT IS CLAIMED IS :~~

1 - a method for forming a planar flexible web into a collapsible tubular shape defined by the surface of a forming mandrel about which successive increments of said web are wrapped, whereafter the adjacent edges of each increment, which extend longitudinally of said mandrel, are connected to each other to constitute a longitudinal seam of the tube thus produced, characterized in that it comprises the steps of

- continuously feeding said web along said mandrel in the direction of the longitudinal axis of said web, one face of the latter being in contact with the mandrel surface;
- continuously feeding, at the same time and in the same direction, a flexible elastic band-like sheet member having a width slightly smaller than that of said web, one face of said sheet member being in contact with the other face of said web, and the longitudinal axis of said sheet member substantially coinciding with said longitudinal axis of the web, whereby said sheet member covers a major central portion of said other web surface, while two opposite longitudinal marginal portions of said web remain free of said sheet member;
- guiding the other face of said sheet member so as to apply the latter together with said web around said mandrel, whereby the successive web increments fed along said mandrel are formed into tubular shape while said free marginal web portions extend along a longitudinal mandrel zone in closely adjacent relation with respect to each other;
- and bonding the successive increments of said adjacent free marginal web portions to each other during their displacement along said longitudinal mandrel zone .

2 - The method according to claim 1, wherein said web is constituted by a material which is fusible and weldable at a predetermined temperature, characterized by the fact that said step of bonding said free marginal web portions to each other comprises

- feeding an outer ribbon member and an inner ribbon member along said longitudinal mandrel zone, at a speed and in a direction equal to those of the feed motion of said web, one face of said outer ribbon member being pressed against the outer face of said marginal web portions, and one face of said inner ribbon member being pressed against the inner face of said marginal web portions;

- applying heat to the other face of said outer ribbon member and to the other face of said inner ribbon member, over an initial portion of the length of said longitudinal mandrel zone, so as to heat said marginal web portions through the ribbon members at least to said fusing temperature and to weld them to each other;

- and cooling said other ribbon member faces at least over a part of the remaining length of said longitudinal mandrel zone, so as to cool the welded marginal web portions through said ribbon members.

3 - The method according to any of claims 1 and 2, characterized in that said marginal web portions are brought into an overlapping portion along said longitudinal mandrel zone, the inner ribbon member being applied against the inner surface of the underlying marginal web portion, and the outer ribbon member being applied to the outer surface of the overlying marginal web portion.

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4 - A device for carrying out the method according to any of claims 1 to 3, comprising a forming mandrel and means for feeding along the latter a web to be formed into tubular shape about said mandrel, characterized in that said web feeding means are adapted to feed the web continuously and in the direction of the longitudinal axis of the web in such a way that one face of the latter engages the peripheral surface of the mandrel, a flexible elastic band having a width smaller than that of said web being fed by hand feeding means in a direction and at a speed equal to those of the web feeding motion, one face of said band being in contact with the other web face, and the respective longitudinal axes of said band and said web substantially coinciding with each other; said mandrel being located within a guiding member a concavely curved guiding wall of which coaxially surrounds a major portion of the periphery of said mandrel so as to define therewith a guiding passage having a radial width substantially equal to the combined thicknesses of said web and said band, for guiding said band together with said web along said mandrel and applying them to the periphery thereof; bonding means arranged along the remaining minor longitudinal portion of the mandrel periphery which is not surrounded by said guiding wall, for bonding to each other the opposed longitudinal marginal portions of said web, which are displaced in closely adjacent relationship along said minor mandrel periphery portion.

5 - The device according to claim 4, characterized in that said mandrel has a circumferential dimension smaller than the width of said web, whereby said marginal web portions overlap each other along said longitudinal mandrel zone.

6 - The device according to claims 4 and 5, characterized in that a longitudinal portion of said mandrel located upstream with respect to the web feed direction has a diameter slightly smaller than the inner diameter of the finished tube, whereas the remaining downstream portion of said mandrel has a diameter substantially equal to said finished tube diameter said concavely curved guiding wall having corresponding longitudinal upstream and downstream portions the first of which has a diameter correspondingly smaller than the diameter of the downstream portion of said guiding wall.

7 - The device according to any of claims 4-6, characterized in that said elastic band is an endless band guided over a plurality of rollers at least one of which is connected to rotary driving roller driving means, one brim of said band being disposed within said guiding channel.

8 - The device according to any of claims 4-7, characterized in that said bonding means comprise an outer endless ribbon of heat conducting material guided over at least two rollers at least one of which is connected to rotary roller driving means, one brim of said outer ribbon being arranged along said longitudinal mandrel zone and having its outer face directed toward the mandrel, while the inner face of an upstream portion of said ribbon brim engages the heating surface of a heater, and the inner face of downstream portion of said brim engages the cooling surface of a cooler, said

bonding means further comprising an inner endless ribbon of heat conducting material guided over at least two rollers at least one of which is connected to rotary roller driving means, one brim of said inner ribbon being arranged in a longitudinal groove of said mandrel, which extends along said longitudinal mandrel zone and which has a depth substantially equal to the thickness of said inner ribbon, an upstream portion of the bottom of said groove constituting the heating surface of a heater disposed within said mandrel, and a downstream portion of said groove bottom constituting the cooling surface of a cooler arranged within said mandrel, said rotary driving means being adapted to drive said ribbons in such a way, that said brims of the inner and outer ribbons, respectively move at a speed and in a direction equal to that of the web feed motion.

9 - The device according to any of claims 4-8, characterized in that said mandrel and said guiding member are provided with internal ducts opening at a plurality of locations into said guiding channel and connected to a pressure gas source, for providing a lubricating gas film on the mandrel surface and said concave guiding wall.

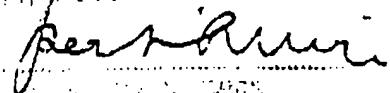
10 - The device according to any of claims 4-9, characterized in that at least one concavely profiled guide roller is provided adjacent said mandrel at a location opposite said longitudinal mandrel zone.

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11 - A method substantially as disclosed herein above ,
particularly with reference to Fig. 1-5 of the appended
drawings.

12 - A device substantially as disclosed hereinabove,
particularly with reference to Fig. 1-5 of the appended
drawing.

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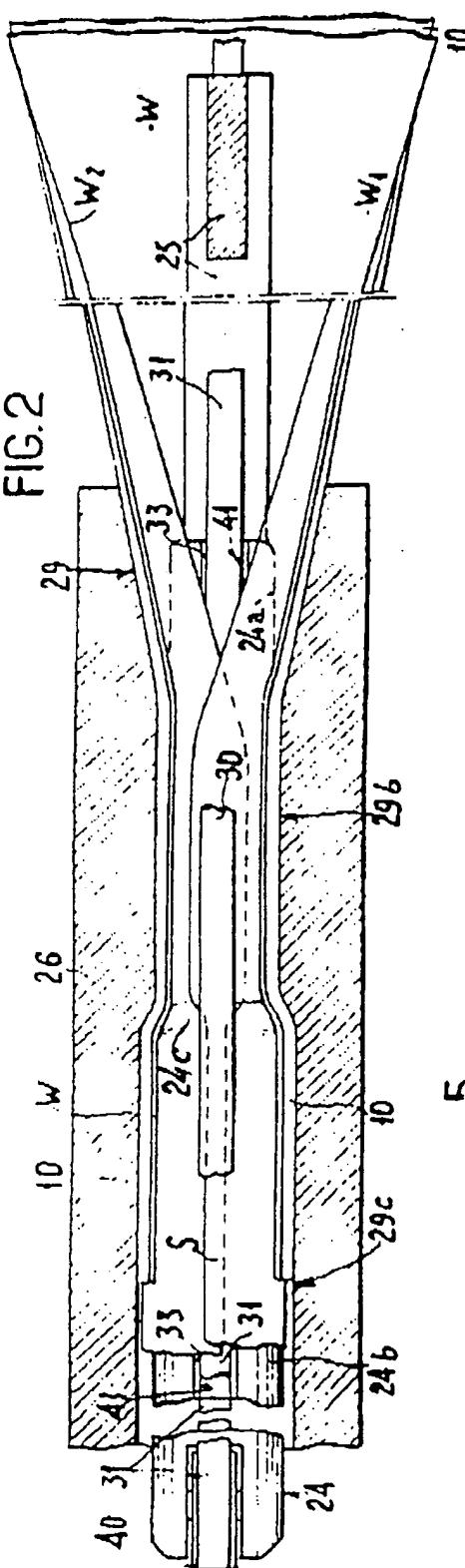
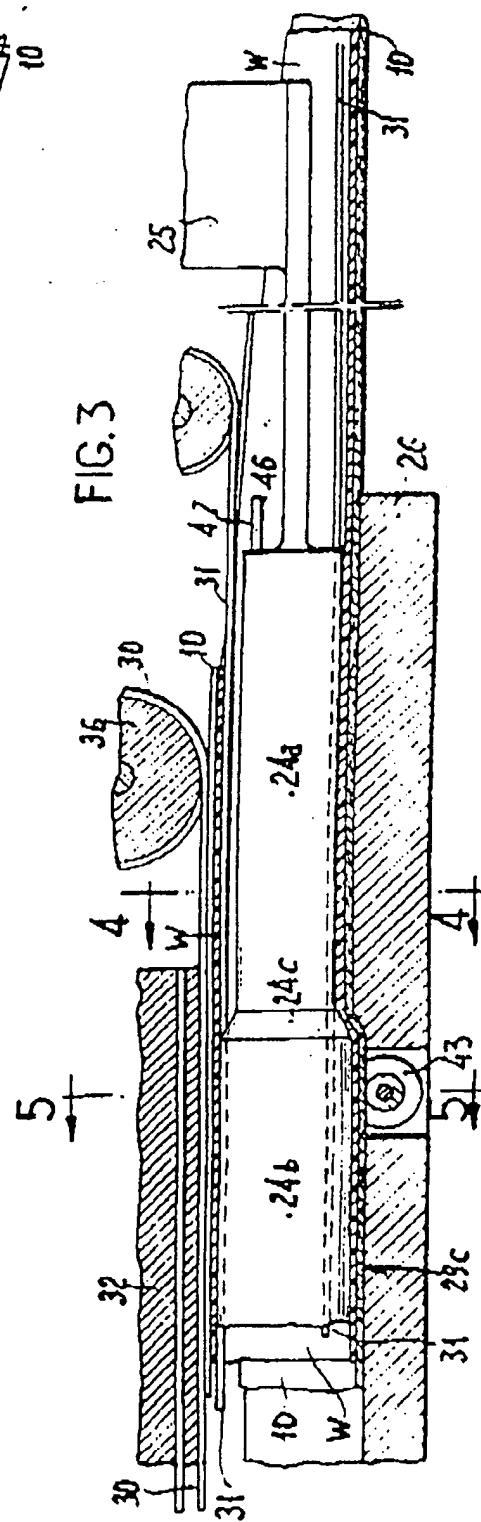


FIG. 3



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FIG.4

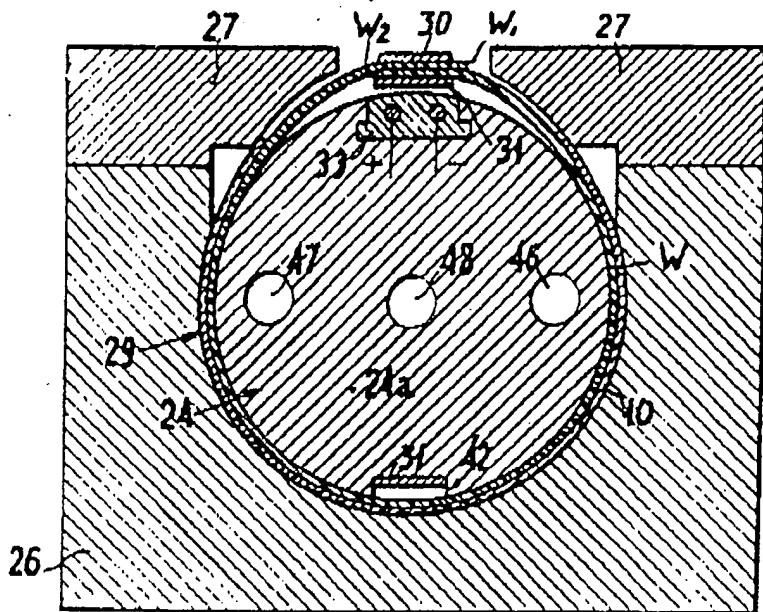
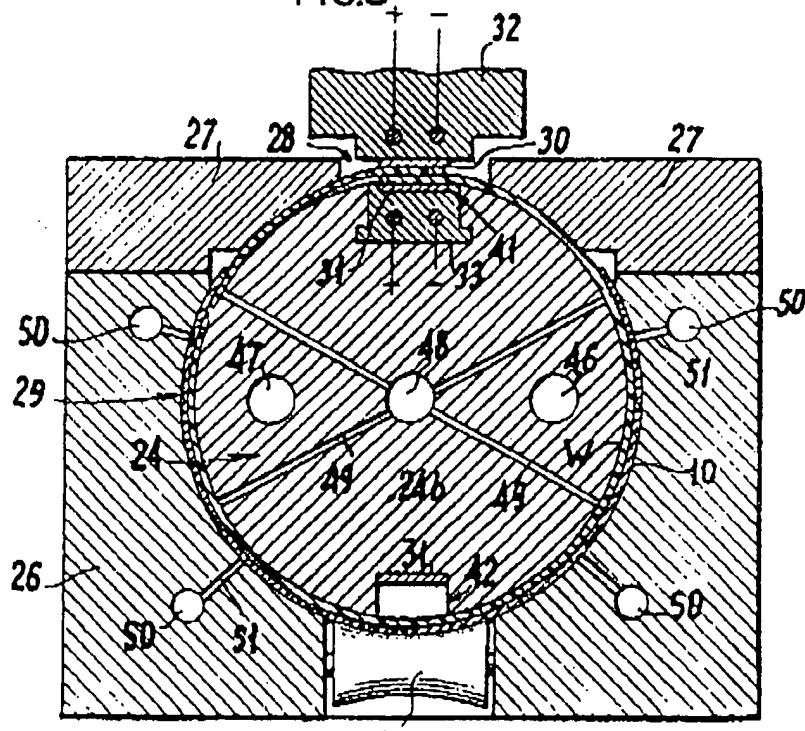


FIG.5



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